THE FOSSIL ANNELID GENUS HAMULUS MORTON, AN OPERCULATE SERPULA.

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INTRODUCTION.

Among some of the recent discoveries in the large and well-preserved Ripley Fauna of the Upper Cretaceous at Coon Creek, McNairy County, Tennessee, are a number of opercula from the Serpula *Hamulus* Morton. Species of this genus are widely distributed in the Cretaceous, but if the opercula have ever been found previously they are still unknown in the literature; so it is the purpose of this brief paper to describe one new species and the calcareous opercula from two species of this interesting group of fossil annelids.

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GENERAL REMARKS.

The Sea-worms or Polychaeta included in the suborder *Tubicola* are distinguished by the fact that they inhabit variously formed tubes, to which they are not organically connected, and in which they can move freely by means of their setigerous foot tubercules. Owing to their possession of an investing tube branchiae are only developed in the anterior region of the body, this being the only part which is ordinarily exposed to the action of sea water; hence the *Tubicola* are sometimes called the "cephalo-branchiate" Annelids.[1]

The protecting tube of the Tubicolar Annelids may be composed of calcium carbonate, of grains of sand, or other foreign matter, or of chitinous material. When the tube is calcareous it presents certain resemblances to the shells of some of the Mollusks, such as *Vermetus*, *Dentalium*, or certain of the Rudistes. In the living state it is easy to make a distinction between these, for the Tubicolar Annelids are in no way organically attached to their tubes, whereas the Mollusks are always attached to their shell by proper muscles. In the fossil condition, however, it may be very difficult to refer a given calcareous tube to its proper place. As a general rule, however, the calcareous tubes of Annelids, such as *Serpula*, are less regular and symmetrical

[1] Nicholson and Lydekker, Manual of Palaeontology, ed. 3, vol. 1, Edinburgh and London, 1889.

than those of *Vermetus*, while the latter are partitioned by shelly septa, which do not exist in the former. Again, the tube of *Dentalium* is open at both ends, whereas it is closed at one end of the *Serpula*. In the Annelidous genus *Ditrupa*, however, the tube is open at both ends, so that this distinction is one not universally applicable. The tubes of the serpuloid genus *Hamulus* are quite regular and symmetrical and its species have frequently been described as *Dentalia*. Tubes of certain species of *Hamulus* together with their opercula have a superficial resemblance to certain species of Rudistes such as *Radiolites lombricalis* d'Orbigny [2] and *Hippurites variabilis* Munier Chalmas [3] from the Upper Cretaceous of France. The apophyse of the operculum of *Hamulus* resembles very much the apophyse of the upper valve of certain of the Rudistes, but the operculum of *Hamulus* is truly an operculum of a circular aperture, while the upper valve of the Rudistes does not fit into a circular cavity of a lower valve. Another difference is the absence of any evidence of muscular attachments on the inner surface of the tubes of species of *Hamulus*.

The operculate form *Hamulus onyx* Morton is probably related to some such form as the existing species *Serpula contortuplicata* [4] (pl. 9, fig. 4). There are existing quite a group of Serpulas with calcareous opercula; these are the Vermilias that are still abundant along the sea coasts to-day. Existing species with chitinous opercula are quite common and some of the forms that may be cited as analogous to *Hamulus onyx* are *Enponatus dipona* Schmarda and *Pomatoceros tetraceros* Schmarda [5] both from near New South Wales; and also *Crucifera websteri* Benedict [6] and *Spirobranchus giganteus* (Pallas) Mörch [7] from the Gulf of Mexico.

Fossil operculate Serpulas are rare. Among these may be mentioned the English Eocene species *Serpula crassa* Sowerby [8] (pl. 10, fig. 11), and the Maryland Upper Cretaceous form *Ornataporta marylandica* Gardner.[9] The former has a calcareous operculum and a three-sided tube, which is usually attached along one side to some foreign object. Gabb has described some serpuloid tubes with a triangular cross section, *Paliurus triangularis* Gabb [10], from the Upper Cretaceous at Vincentown, New Jersey. Gabb's species has no known operculum, but its triangular tubes are somewhat analogous to those of Sowerby's Eocene species. There are specimens of *Serpula heptagona* [11] with opercula from the Barton Beds of the Eocene of England in the British Museum.

[2] d'Orbigny, A., Paléontologie Française, Terrains Crétacés, vol. 4, 1860, p. 214, pl. 555, figs. 4–7.
[3] Douvillé, H., Mem. Société Géologique de France, Mem. no. 6, p. 50, pl. 7, figs. 4–7, 9–12, 14, 15.
[4] Nicholson and Lydekker, Manual of Paleontology, 1889, p. 471, fig. 333*a*.
[5] Schmarda, Ludwig, K., Neue wirbellose Thiere, 1861, p. 30, pl. 21, fig. 179, Leipzig.
[6] Benedict, J. E., Proc. U. S. Nat. Mus., vol. 9, 1886, p. 550, pl. 21, figs. 24, 25.
[7] Idem, p. 551, pl. 23, figs. 38–42; pl. 24, figs. 43–47.
[8] Agassiz, L., German edition of James Sowerby's Mineral Conchology, 1814, 1842, p. 52, pl. 30.
[9] Gardner, J. A., Maryland Geological Survey, Upper Cretaceous volume, 1916, p. 748, pl. 47, figs. 16–18.
[10] Gabb, W. M., Proc. Acad. Nat. Sci. Philadelphia, 1876, p. 324, pl. 17, figs. 11–13.
[11] Guide to the Fossil Invertebrate Animals in the British Museum, ed. 2, London, 1911, p. 79.

SYSTEMATIC DESCRIPTIONS.

Class ANNELIDA.

Order POLYCHAETA.

Suborder TUBICOLA.

Family SERPULIDAE.

Genus HAMULUS Morton.

Hamulus MORTON, Syn. Org. Rem. Cret. Group, 1834, p. 73.

Type.—Hamulus onyx Morton.

"Tubular, regular, involuted; volutions distinct; aperture circular." Morton, 1834.

Tubes with from three to seven axial ribs; larval or early stages attached, usually broken away and solitary in the adult; nuclear shell portions circular and often triangular in cross section; inner surface of the tubes smooth; operculum calcareous, consisting of a circular anterior disk with a three-cornered, elongate posterior process or apophyse.

HAMULUS ONYX Morton.

Plate 9, figs. 1, 2, 3, 5, 6.

Hamulus onyx MORTON, 1834, Syn. Org. Rem. Group, p. 73, pl. 2, fig. 8; pl. 16, fig. 5.—GABB, 1859, Cat. Inv. Fossils. Cret. Form. U. S., p. 1.—STEPHENSON, 1914, U. S. Geol. Surv. Prof. Paper 81, p. 24, tables 2, 8.—GARDNER, 1916, Md. Geol. Sur. Upper Cret., p. 747 (part).

Description.—"With six elevated, angular, longitudinal ribs extending from base to apex. Length about an inch. The imperfect specimen figured on Plate II was obtained by Dr. Blanding at Lynchs Creek, South Carolina, in the green sand, and on a former occasion was supposed to be a *Dentalium*. Plate XVI, figure 5, however, represents the perfect shell from the older Cretaceous deposits of Erie, Alabama. I have a small individual from New Jersey. It has never been found attached." Morton, 1834.

Type locality.—Erie, Alabama.

Tube small, compact, and rather strong; in form a very elongate, gently curved, ribbed, or corrugated cone; shell of tube made up of two layers—an inner layer of lamellar calcareous material, and an outer layer of chitinous calcareous material bearing the external sculpture; nucleus or protoconch unknown, tube attached to some foreign object during nuclear stage; external sculpture consisting of six prominent axial ribs and sulci; transverse or incremental lines fine and very numerous in some individuals, quite obscure in other individuals; internal surface smooth; aperture circular; apertuarl

margin smooth and sharp; operculum tack-shaped with a three-cornered spick or tooth situated on the edge of the tack head or basal circular plate; anterior surface of basal plate concave marked with a few fine lines radiating from the center and a few irregular concentric lines; posterior side of the basal plate and the sides of the three-cornered tooth or apophyse marked by irregularly ramifying and deeply impressed grooves or sulci which probably represent the seats of muscular or ligamental attachments; posterior extremity of the tooth pointed and tripartate; operculum in place is entirely behind the anterior margin of the aperture, thus forming a watertight stopper for the tube.

This species is one of the commonest fossils in the Ripley formation at Coon Creek. It is represented in the collections from that locality by hundreds of specimens, several dozen of which retain the operculum in place. A few immature forms have been found attached, but none of the specimens preserve the complete nucleus. This is broken away from all the specimens examined, leaving the apices perforate. This species is somewhat similar to the species *Hamulus jonahensis* (Cragin) [12] from the Austin Chalk of Texas, but does not possess the vigorous incremental sculpture that characterizes the tubes of the Texas species. The species *Serpula sexsulcata* Münster,[13] a species of *Hamulus*, from the Upper Cretaceous of Germany, has six axial ribs on the tube, but most commonly the European species of this genus are characterized by seven ribs instead of six. Two of these are:

Dentalium deformis d'Orbigny [14] (pl. 9, figs. 7, 8) from the Cenomanian, Le Mans, France; and *Serpula septemsulcata* Reich and Cotta [15] (pl. 2, fig. 10) widely distributed in the Cenomanian of Saxony and especially abundant in the Serpulitensand of Bannewitz near Dresden. The Ripley species *Hamulus major* Gabb [16] from Eufaula, Alabama, has only three or four low axial costae on its tubes which are less regular and symmetrical than the type species of this genus. The Oxfordian species *Serpula vertebralis* Sowerby,[17] a Jurassic species found in both England and in France, has only four axial ribs, but in many respects it resembles *Hamulus onyx* Morton and should be included in the genus *Hamulus*.

Occurrence.—Ripley Formation. Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collections.—Philadelphia Academy of Natural Sciences. Johns Hopkins University. Vanderbilt University. U. S. National Museum (Cat. No. 32460).

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[12] Cragin, F. W., Fourth Ann. Rept. Geol. Survey of Texas, 1893, pl. 29, figs. 12–14, Austin.

[13] Goldfuss, Petrefacta Germaniae, vol. 1, p. 238, pl. 70, fig. 13.

[14] Geinitz, H. B., Grundriss der Versteinerungskunde, p. 252, pl. 16, fig. 18*a*, *b*, *c*. Dresden, 1842.

[15] Wanderer, K., Tierversteinerungen aus der Kreide Sachsens, 1909, p. 21, pl. 3, fig. 12, Jena.

[16] Gabb, W. M., Journ. Acad. Nat. Sci. Phila., 1860, p. 399, pl. 68, fig. 46.

[17] Sowerby, Mineral Conchology, pl. 599, figs. 6–9. Bronn, H. G., Lethaea Geognostica, vol. 6, p. 415, pl. 27, fig. 5*a*, *b*. Stuttgart, 1852.

Outside Distribution.—*Monmouth Formation* of Maryland; *Selma* and *Ripley Formations* of Mississippi, Alabama; *Eutaw Formation* of Alabama; *Austin Chalk*, Texas.

HAMULUS ANGULATUS, new species.

Plate 10, figs. 1, 2, 8, 9.

Description.—Tube small, thick, and strong, but brittle; in form an elongate, gently curved, and often slightly spiral cone; inner shell layer thick, outer layer thin; nucleus unknown; external surface marked by six low, sharp, angular, axial ridges; interaxial spaces broad and gently concave, alternate interaxial spaces marked by a fine impressed axial line; growth lines obscure on the earlier stages of the shell; interrupted growth lines, irregular and common near the aperture; aperture circular, its margin smooth and thin; internal surface smooth.

Dimensions.—Imperfect specimen—length, 8 mm.; maximum diameter, 3.5 mm.

The tubes of this species are brittle and are usually broken. They may be readily distinguished from those of *Hamulus onyx* Morton by their low, angular axial costae, broad smooth, gently concave interaxial spaces, and by the impressed axial line in alternate interaxial spaces.

Occurrence.—*Ripley Formation.* Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collections.—Johns Hopkins University. Vanderbilt University. U. S. National Museum.

Cotypes.—Cat. No. 32459, U.S.N.M.

HAMULUS SQUAMOSUS Gabb.

Plate 10, figs. 6, 7.

Hamulus squamosus GABB, 1859, Cat. Inv. Foss. Cret. Form. U. S., p. 1; 1860, Journ. Acad. Nat. Sci., Phila., ser. 2, vol. 4, p. 398, pl. 68, fig. 45.—STEPHENSON, 1914, U. S. Geol. Surv. Prof. Paper 81, p. 24, table 2, 8.

Description.—"Elongated, curved at the narrow end into a hook sometimes with as much as three-fourths of a whorl, all in the same plane; mouth slightly constricted, nearly circular, edge thin; surface marked by two or three wrinkled longitudinal folds on each side and a heavy squamose plate, very irregular in the plane of the curve on each side."

Dimensions.—"Length about 1 inch exclusive of the curve; greatest width of the plates 0.4 inch, diameter of mouth 0.12 inch." Gabb, 1860.

This species is closely related to *Hamulus onyx* Morton, but may be readily distinguished by the broad wing-like appendages on the first and fourth axial costae. *Hamulus squamosus* Gabb is evidently a mud-loving form since it is extremely rare in the Coon Creek beds and common in the Selma clay.

Occurrence.—Ripley Formation. Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collection.—U. S. National Museum (Cat. No. 32461).

Outside Distribution.—Ripley Formation, Lees Mill, Mississippi. *Selma Chalk,* Mississippi, Alabama, Georgia.

HAMULUS, species.

Plate 10, figs. 3, 4, 5.

Operculum small and fragile, consisting of a circular disk and an elongate three-cornered posterior process or apophyse; circular disk marked on both the anterior and posterior sides of lines radiating from the center; margin of disk slightly serrate; position of apophyse on the disk eccentric.

This species of operculum is known from a single individual which was found detached from a tube. It is most likely that it belongs either to *Hamulus squamosus* Gabb or *Hamulus angulatus*, probably the latter.

Occurrence.—Ripley Formation. Dave Weeks place on Coon Creek, McNairy County, Tennessee.

Collection.—U. S. National Museum (Cat. No. 32462).

EXPLANATION OF PLATES.

Plate 9.

Fig. 1. Operculum of *Hamulus onyx* Morton. × 10, front view.
2. Operculum of *Hamulus onyx* Morton. × 10, basal view.
3. Operculum of *Hamulus onyx* Morton. × 10, rear view.
4. *Serpula contortuplicata*, a recent operculate Annelid. figure taken from Nicholson and Lydekker. *O.*=operculum.
5. *Hamulus onyx* Morton. × 4, side view.
6. *Hamulus onyx* Morton. × 4, basal view showing operculum in place.
7. *Hamulus deformis* (d'Orbigny). × 4, side view, an imperfect specimen from the Cenomanian, Le Mans, France (Cat. No. 32463 U.S.N.M.).
8. Same as figure 7. × 4, apertural view.

Plate 10.

Fig. 1. *Hamulus angulatus* new species. × 4, side view.
2. Same as figure 1. × 4, apertural view.
3. Operculum of *Hamulus*, species. × 10, front view.
4. Operculum of *Hamulus*, species. × 10, basal view.
5. Operculum of *Hamulus*, species. × 10, rear view.
6. *Hamulus squamosus* Gabb. × 4, side view.
7. Same as figure 6. Apertural view.
8. *Hamulus angulatus*, new species. × 4, side view showing one of the three axial depressions.
9. Same as figure 8, × 4, apertural view.
10. *Hamulus septemsulcata* Reich and Cotta, a species common in the Cenomanian of Saxony. Figure taken from Wanderer.
11. *Serpula crassa* Sowerby an operculate annelid from the Eocene of England, figure taken from L. Agassiz.